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ABSTRACT

There is a need for artists and for art educators to know about current research into different ways of thinking pertinent to both the creation and perception of art. Brain hemispheric research has stimulated new ideas about teaching processes that nurture spatial thinking and bring a positive new force to the studio and classroom. An introduction places the topic in context both in terms of historical awareness of different modes of thinking and in terms of recent research and popularization. Chapter 1 presents an overview of recent brain hemisphere research and its relevance to artists and art educators. Chapter 2 lists and concisely reviews 36 books. Chapter 3 addresses 89 journal articles in the same manner. The books and articles are listed alphabetically by author and include titles, publication, source, and other bibliographic information. Concluding comments assert that while the topic is relevant to creating and teaching art, the concept of two separate and distinct sides of the brain is inappropriate and oversimplified. An appendix lists 40 book titles that are peripherally related to the topic. (Author/DCW)

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CONTEMPORARY RESEARCH IN BRAIN HEMISPHERIC SPECIALIZATION

FOR ARTISTS AND ART EDUCATORS

AN
ANNOTATED
BIBLIOGRAPHY

Deborah Curtiss

Thesis for Master of Arts
in Art Education
Philadelphia Colleges of the Arts

© December 1982

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Abstract

Contemporary Research in Brain Hemispheric Specialization

For Artists and Art Educators

An Annotated Bibliography

The introduction places the topic in context both in terms of historical awareness of different modes of thinking, and in terms of recent research and popularization. Chapter I presents an overview of recent brain hemisphere research and its relevance to artists and art educators.

In Chapter II 36 books are listed and concisely reviewed, and in Chapter III 89 articles are likewise addressed. The books and articles are listed alphabetically by author; titles, publication, and bibliographic information are included.

Concluding comments assert that while the topic is relevant to the making and teaching of art, thinking of the two sides of the brain as separate is inappropriate and over simplified. The definitive work that addresses the complexity of cognition engaged by visual art making and appreciation is yet to be written.

The Appendix lists 39 book titles that were found to be peripherally related to (and thus helpful in framing) the topic.

Bibliography. iii + 43 pp. Masters Thesis, Philadelphia College of Art, 1982.

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ACKNOWLEDGEMENTS

Since 1972 when I first learned of Roger W. Sperry's work, I have felt that brain hemispheric research would have interest and relevance for artists and art educators. Just how to present this research in a way that would be accessible, and at the same time fulfill the requirements for a thesis, was initially complex and elusive.

Enduring my many frustrations and preliminary attempts to communicate this material, were Robert Sebastian, William B. Russell, and William Webster. I thank them for their forebearance.

Frederick Osborne became my advisor when the proposal was first drawn, and survived to the completion of the thesis, generously giving his time, thoughts, and support through thick and thin. His patience and confidence are deeply appreciated.

Thanks too to Arlene Gostin who, upon returning from sabbatical, found me stalled on this work. She joined my committee and provided encouragement, perserverence, and coherence.

Especial thanks for Patricia Cruser who provided the idea of an annotated bibliography. This one suggestion led to a format that was instantly clear and all but self-fulfilling in writing this work. Her meticulous reading of the several drafts also helped immeasurably to bringing it all together.

While most are nameless, mention is due to the many librarians who provided tremendous assistance. Their delight and cooperation in providing information and help for anything from the most trivial to the most cosmic questions, was one of the finest discoveries I made during my research. They have my utmost respect and gratitude.

Linda Lee was my helpful and accurate typist with equipment and ambience provided by the Admissions Office of Philadelphia College of Art, Caroline Kelsey, Director. They too have my warm thanks.

INTRODUCTION

Much I owe to the Lands that grew -
More to the Lives that fed -
But most to the Allah Who gave me two
Separate sides to my head.

Much I reflect on the Good and the True
In the faiths beneath the sun
But most upon Allah Who gave me two
Sides to my head, not one.

I would go without shirt or shoe,
Friend, tobacco or bread,
Sooner than lose for a minute the two
Separate sides of my head!

- Rudyard Kipling[1]
1901

For centuries poets have given voice to their experience of having two minds, but little heed was paid. Medical pioneers of ancient Greece knew that the forebrain had two hemispheres, but one, usually the right, seemed to be useless. Subsequent observations found it mute, such that when damaged by accident or stroke, little loss was apparent compared to similar damage to the left hemisphere.[2] Since then poets have been allowed their license, while the rest of humanity has lived as if one way of thinking was all we had, and all that required educating.[3]

In 1981, neuropsychologist Roger W. Sperry received a Nobel Prize for his research findings in cerebral anatomy and function. This recognition was prefaced by many years of speculation, research, and verification. In 1952 he

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[1]"The Two-Sided Man," Rudyard Kipling's Verse Inclusive Edition, Garden City, NY, Doubleday Page, 1919, p. 652, verses 1, 2, and 5.

[2]Maya Pines, The Brain Changers, New York, Harcourt, Brace, Jovanovich, 1973, pp. 143-4

[3]Elliot W. Eisner and David W. Ecker, eds., Readings in Art and Education, Waltham, MA, Blaisdell, 1966, p. 10

published "Neurology and the Mind-Brain Problem"[4] in which he reported early neurological evidence of different modes of thinking. Nine years later he became involved with a radical surgical procedure to bring relief to severe sufferers of epilepsy. This entailed the removal of the corpus callosum, a thick membrane or commissure of nerve fibers, which is located between the two hemispheres of the cerebrum or forebrain.

This procedure not only greatly reduced the frequency and intensity of epiliptic seizures, and in some cases eliminated them altogether, it also yielded the discovery that these commissurotomy patients evinced some unexpected behavior. As an experimental psychologist, Sperry set out to understand the nature and underlying causes of these behavioral manifestations.

The results of this research were first published in 1963 under the title "Lateral Specialization of Cerebral function in the Surgically Separated Hemispheres."[5] Sperry reported that these commissurotomy patients had two distinct modes of thought localized respectively in the left and right hemispheres of the cerebrum. His findings generated considerable excitement among psychologists, psychiatrists, neurophysiologists, and inspired more speculation, research, and further verified findings, in the nature of thinking and human behavior.

By 1972, this research reached the popular press and my attention.[6] Intuitively and subjectively I recognized the validity of the discoveries from my own vivid experiences in thinking about and making art. The annotated bibliography on brain hemispheric research for artists and art educators that follows is comprised of many separate works. It is hoped that it will help other artists to incorporate various modes of thinking into their lives and work.

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[4]R.W. Sperry, "Neurology and the Mind-Brain Problem", American Scientist, 1952, 40, pp. 291-312

[5]F.J. McGuigan and R.A. Schoonover, eds., The Psychophysiology of Thinking, New York, Academic, 1973, pp. 209-29

[6]Pines, op. cit.

CHAPTER I

OVERVIEW

In preparing this bibliography, no simple organizational form appeared to be intrinsic in the material, so I have presented the books and articles alphabetically by author. An overview will assist the reader in putting the research findings in a meaningful context. The overview is purposely concise and uninterrupted by citations which may be found in abundance under the authors' names in the Bibliography itself.

Roger W. Sperry and his colleagues found that the left hemisphere of the brain deals with information in an analytical, linear, sequential, and verbal manner. (For some left-handed persons these processes may be located in the right hemisphere, but for the sake of clarity, I will stay with the majority of 90-95%.) Because the left hemisphere contains the centers of verbal language, we have allowed it to dominate education and thinking, and we have relegated other modes of thinking to speculative obscurity. As a result, the left hemispheric mode of thinking, according to Sperry, has received the most training and most of the stimulation in western education.

Sperry also discovered that the right hemisphere, although non-verbal (and thus historically considered mute, dumb), is important in solving visuospatial tasks such as spatial relations, puzzle or block construction, symbol completion, and imagistic encoding. Thus the right mode of thinking is concerned with totalities, is holistic, spatial, integrative, and intuitive.

Several of the author-researchers who took up Sperry's lead treated the normal brain as if it too were split—as if it were in two distinct parts (Bogen, Gazzaniga, Ornstein). That the corpus callosum transmits information from one hemisphere to the other in less than 3 billionths of a second seemed to have little effect upon the speculations on distinctly different modes of thinking.

Jerre Levy, who worked with Sperry as a graduate student, realized that most of the subjects of Sperry and followers were male, as were most hemispherectomy patients (veterans). In her own work, Levy began to study

female patients (commissurotomies, strokes, head injuries and tumors resulting in severe impairment or removal of one hemisphere), and found that, in general, these modes of thinking are less differentiated and more integrated in women than in men. Springer and Deutsch contend that these differences are too small statistically to reflect any significance, however.

Some dysfunctions, such as dyslexia and psychosis, are speculated to be manifestations of nonintegrated function of the two basic cognitive modalities (Springer and Deutsch). More research and verification is required in this area, and as noted below, these concerns are not part of this paper.

Recent literature on the topic of brain hemispheric differences reflects an acknowledgement of two modes in our thinking, but emphasizes their complementarity and interaction. Instead of separate or different modes of thinking, the degree of dominance of one mode over the other in dealing with a given problem or situation is at issue. The integration of these modes in problem solving has come to be seen as most important and relevant: we draw on both sides of our brain.

Among the popular responses to Sperry's research findings is a claim that in American education the arts have been neglected and we have been educating only one side of the brain.[7] Because the arts are perceived as stimulating and requiring visuospatial thinking, a new emphasis has been placed on art and art education. As a result, much has been written, both speculative and factual, about the new role the arts must play.

A question which I had hoped would be answered in the course of my research, by an articulate and convincing recognized authority, was, why is knowledge of brain hemispheric function important to the artist and art educator? To respond to this, I must rely upon my own experience as an artist and teacher, endeavoring to be as objective as possible, and combine that with the reading I have done in preparing this paper.

The evidence is great that this mute spatial thinking is a kind of thinking that is engaged to a higher degree when solving a visual problem in an art class then it is in navigating across a room without bumping into objects. The development of the right mode of thinking through visual problem solving

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[7] McGuigan and Schoonover, op. cit., p. 227
See also, Robert Ornstein, The Psychology of Consciousness, New York, Viking, 1872, p. 5ff.

and creating art, will thus contribute to the cognitive development of an individual just as it is acknowledged that reading and writing do. One will enhance visuospatial cognition, the other logico-sequential cognition.

Art students on their way to becoming artists often have an experience of gradually or suddenly shifting into a mode of seeing-thinking which is referred to as "transformed" or "transformative vision".[8] While this entails a complex integration of dichotomous elements, it is also the ability to see forms in space as they relate to one another from one's particular, or perspectival, point of view. This seeing is uncensored and unfettered by any other information we might know about the objects being depicted. For example, when a student depicts a hand thrust toward her/him as small, and revealing the arm behind it, she/he knows the hand to be 3/4 the length of the forearm, so how can it possibly obliterate the forearm altogether? Or, how can the knuckles be next to the shoulder when we can see perfectly well that the arm is fully extended?

Is it not the cataloguing, informational left mode of thinking that is getting in the way of accurately seeing the relative hand-enlargement that takes place due to its closeness compared to the rest of the arm? Recognizing the conflict in the student's thinking, the persistence of the logical mode of thinking, the art teacher can assist the student in breaking free from that dominance when she/he has the verbal vocabulary and understanding to identify the problem. Moreover, the teacher can devise drawing exercises which bypass the left mode thinking or "trick" it into a more subordinate role as appropriate.[9]

An art teacher who has an understanding of these workings of the human mind need not rely any longer upon a hit-or-miss approach to accurate seeing. Authorities have given credence to teaching processes that nurture spatial thinking and bring a positive force to the studio or classroom. As relatively new teaching tools, the potential of these procedures are in the process of being tested and verified. The preliminary results appear to be positive. Through use of the experience of these educators, art teachers have an opportunity to expand curricula and learning.

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[8]Jose Argüelles, The Transformative Vision, Berkeley, CA, Shambala, 1975, p. 4

[9]Betty Edwards, Drawing on the Right Side of the Brain, Los Angeles, J.P. Tarcher, 1979, pp. 42-3

This is a sound reason for artists, for the sake of their own seeing and work, and for art educators, for the sake of their students, to become knowledgeable about the scientific support of different ways of thinking that are pertinent to both the seeing and the creation of art. An annotated bibliography of books and articles that have been written about this brain research in general, and specifically on the implications of this research for artists and art education seems both timely and helpful.

There are two basic parts to this bibliography. The first is a listing of book titles and abstracts, and the second is titles of articles, some with abstracts. They are organized alphabetically by author, and the method of selection precedes each section. An appendix lists titles of books which were considered but not chosen for the bibliography because they were insufficiently germane to the specificity of the topic.

CHAPTER II

BOOKS

Methodology

While various bibliographies and bibliographic guides were consulted, the primary resource for the titles listed below was the bibliographic listings found in the books and articles. One book simply led to another, and to another, and on and on, until no new titles were found.

Because neither of the art and architecture bibliographies contained pertinent listings, to double check that no titles were missed, I consulted Subject Guide to Books in Print under the subject headings, "Brain" (general) and subheadings, "Localization of Functions," and "Research." Forthcoming Books has no subject guide, so only a spot check of key authors and hoped-for titles, such as "Art and the Brain" and vice versa, was undertaken.

Most of the books included were written for the generally educated reader. Where more specialized books were considered, it was usually because of a pertinent chapter or paper contained therein. Highly technical, anatomical texts are prohibitive to read for someone without a medical education, so they have not been included for review. Some are listed in the Appendix for those who wish more scientific explanations.

In the final analysis, it was I who decided the relevance of a book to the purpose of this bibliography. Had every book considered been included, the result would have been cumbersome and counter-productive to the provision of a usable tool for artists and art educators.

Although peripherally related, the scope of this bibliography does not include:

1. Research pertaining to pathologies, psychoses, and dysfunctions of the brain, except where these conditions have served to illuminate the functioning of healthy persons, particularly artists and students.

2. Handedness. Handedness and art or creativity is a topic quite by itself, and amply represented in the literature.

3. Art therapies that are utilizing research findings in brain hemispheric differentiation. While related and interesting, this topic is worthy of separate consideration.

4. General creativity. This large topic is mostly excluded, but issues of creativity that relate directly to visual art and hemispheric function are included.

5. Perception. The overlap of perception and brain hemispheric research is large and fascinating, and has resulted in simplification in the description of some perceptual phenomena. However, the topic is too copious to be included here.

6. Books on the brain. There are many books, both technical, and for the lay reader, on the function of the human brain. If a book did not include hemispheric function research, it was not included for review.

7. Other states of consciousness. As hemispheric functioning raised questions about consciousness, a tempting direction of investigation and speculation is into altered states of consciousness, hypnosis, parapsychology, and psychedelic experience. These too are considered outside the scope of this paper.

Some of the connections of brain hemispheric research and art with these areas are listed in the appendix.

For the sake of simplicity and directness, what follows are the books which could help the artist and art educator learn about brain hemispheric research and its pertinence to the creating and teaching of art.

Adams, James J., Conceptual Blockbusting
N.Y., W.W. Norton, 1976

Adams uses drawing as a conceptual aid for his engineering students at Stanford University in order to develop visual imaging as a thinking mode. He believes that drawing is a thinking technique as well as a communication device and is invaluable in problem solving. Justifications of this belief and examples of drawing problems are given.

Argüelles, Jose A., The Transformative Vision: Reflections on the Nature and History of Human Expression
Berkeley, CA, Shambala, 1975, 364p., bib., ind.

Argüelles calls the two modes of thinking and looking at things "psyche" and "techne," and identifies these terms with right and left modes of thinking respectively.

Transformative vision is the ability to synthesize opposites, to perceive how they relate, and to acknowledge that opposites are inextricably

intertwined and dependent upon one another for existence and definition. This synthesizing process utilizes both "techne" and "psyche" modes of thinking in an inter-relational process: "It is techne that physically actualizes the impulses emanating from psyche." (p.4) Art is "the perfect marriage of psychic impulse and technical implementation." (op.cit.)

Argüelles draws upon Oriental and Latin Indian philosophies, as well as European, in order to understand the synergistic setting for all life. There is, in "transformative visionaries," a dialogue between the two hemispheres, a dialogue which is transcendental, encompassing "spheres of consciousness infinitely greater than the individual can perceive." (p.15) As examples, he profiles transformative visionaries such as Blake, Whitman, Goya, Turner.

Argüelles, is an artist and art historian who traces evidence of transformative vision back to ancient history and throughout Oriental history. He also explores how left mode thinking became dominant in occidental societies, resulting in lopsided education.

The effect of photography on perception and art; the influence of dreams; the freeing from the concrete to the imaginative realm of the invisible, metaphysical, and the abstract; are all investigated.

This book is concluded with a call for a reunion of "psyche" and "techne" for the betterment not only of art, but of all life and human experience.

Arieti, Silvano, Creativity: The Magic Synthesis
N.Y., Basic Books, 1976, 448p., bib., ind.

Psychiatrist Arieti describes the major theories of creativity and the psychological components of creativity. Creative products are identified and discussed, and creativity is placed in a sociocultural context. How to cultivate individual creativity is also explored.

Chapter 17, p. 387-404, focuses on the neurology and biology of creativity, giving a concise and professional identification and explanation of the creative cortical areas and functions of the brain. Arieti finds the work of Sperry and Bogen in hemispheric research "intriguing," but by no means conclusive. Instead, he looks at the brain as a whole, identifying the anatomical areas which research has specified as crucial to creative thinking and activity.

Arnheim, Rudolf, Visual Thinking
Berkeley, CA, U. of Cal., 1969, 345p., bib., ind.

A perception psychologist with a passion for art, Arnheim's entire career has been devoted to art and visual perception (also a book by that title, Berkeley, U. of Cal., 1954, 1974). Written prior to the research which led to awareness of differentiated thinking processes, this book is a vivid defense of "visual thinking" as a highly developed cognitive activity, and not the vague "unconscious" or "metaphoric" process to which it had been generally relegated. Visual Thinking expands upon the inextricable interrelationship between spatial and linear thinking, and thoroughly supports Arnheim's contention that "artistic activity is a form of reasoning in which perceiving and thinking are indivisibly intertwined." (p.v.) The systematic training of visual sensitivity he feels is an indispensable part of education, and should not be limited to the arts.

Blakeslee, Thomas R., The Right Brain: A New Understanding of the Unconscious Mind and its Creative Powers
Garden City, NY, Anchor-Doubleday, 1980, 275p., glossary, bib., ind.

To connect the non-verbal thinking processes of the right hemisphere with the "unconscious mind" is an unfortunate misnomer. Written by an engineer/inventor, this book offers clear definitions and explanations of the events, discoveries, and experiments that yielded information about the thinking processes of the right hemisphere. Means to identify one's cognitive style, and to find the synergistic relationship between left and right brain thinking as the real basis for creativity, are also provided.

Additionally, Blakeslee makes a plea for the better educating of the right brain; covers a number of dysfunctions which illuminate the brain's good functioning; covers handedness as it relates to brain function; chronicles maturation and how it affects hemispheric differentiation; looks at how computers are taking over much left brain activity, requiring and freeing the mind for more right brain activity. He recommends understanding and encouragement of "the magical synergy of logic and intuition." (p.181)

I found this author eager to make generalizations upon partial evidence, and reliant upon his own biases and enthusiasms in recommending changes in the way we think and act. This is particularly evident in his comments on gender and hemispheric specialization.

Buzan, Tony, and Dixon, Terence, The Evolving Brain
N.Y., Holt, Rinehardt, and Winston, 1978, 168p., bib., ind., illus.

The entire book reflects an awareness of making art as a cognitive act, and aspects of the processes of making art are interwoven throughout. The authors address the necessity of hemispheric harmony for art endeavors (pp.94-98, 136-139). Generously illustrated.

Buzan, Tony, Use Both Sides of Your Brain
N.Y., E.P. Dutton & Co., 1976, 144p.

This is a general guide for increasing thinking and learning powers, including an "organic study method" to improve brain powers for creative thinking. It contains exercises for right hemispheric thinking and examples of non-linear note taking, such as sketches, diagrams, symbols, etc. It is not intended to specifically apply to the visual arts, but to enhance all learning.

Corrigan, Dorothy D., The Brain Game: Exploring and Activating Your Body's Most Creative Organ
N.Y., Beaufort, 1981, 144p., ind.

The author propounds that more effective use of brain power is achieved "through understanding the structure and physical form of the brain itself," (p.9) and so gives a description of that structure. She also offers exercises to help tap the brain power we all have, and includes a list of activities specifically for stimulating the right hemisphere. (p.48)

DeBono, Edward, Lateral Thinking: Creativity Step by Step
N.Y., Harper & Row, 1970, 300p., illus.

This is a workbook to be worked through slowly - i.e., for months to years - for developing greater facility in lateral thinking (defined in next entry). Some of the problems relate to basic design issues.

Debono, Edward, New Think: The Use of Lateral Thinking in the Generation of New Ideas
N.Y., Avon, 1971, 156p.

"Lateral thinking" is defined as creating new ideas rather than deriving information from the vertical or sequential thinking of logic, mathematics, and computers. It is a kind of 'sideways' thinking useful in problem solving. Because of its concern with generating new ideas and methods, it can be relevant to the solving of visual art problems.

Many puzzles and anecdotes are given to challenge the reader to think laterally. They deliberately invite low probability, humor, accident, serendipity, and chance, for an intended freeing from sequential logic. A mind-training process for lateral thinking is advocated and expanded in the following entry.

DeBono, Edward, The Five-Day Course in Thinking
Baltimore, MD, Penguin/Pelican, 1969, 160p.

As the title suggests, five days are recommended to work through the problems posed in this book to improve thinking, particularly lateral or spatial thinking. In none of DeBono's books does he refer to hemispheric differentiation as such. Lateral thinking as he defines it, however, seems to be visuospatial thinking and quite synonymous with right-mode thinking.

Dimond, Stuart J., Double Brain Experiments
Edinburgh, Churchill Livingstone, 1979, 229p., ind., ref.

This book originated from experiments performed by this neuropsychologist in which the two-brain system of the human brain was examined. There is an emphasis upon the importance of joint function, interaction, and integration of activity. Chapter 6 explores the "Double Brain and Concepts of Skilled Performance," but does not get as skilled as the making of art. It is concerned more with perception and action.

Dimond, Stuart J., and Beaumont, J. Graham, eds.,
Hemisphere Function in the Human Brain
N.Y., John Wiley, 1974, 398p., ind., ref.

Eleven psychologists and six neurophysiologists have contributed a total of 15 papers which report on all known aspects of differentiated hemispheric functioning as of 1974. It includes:

Beaumont, J.G., "Handedness and Hemispheric Function,"

Gazzaniga, M.S., "Cerebral Dominance Viewed as a Decision System,"

Kimura, D., and Durnford, M., "Normal Studies in the Function of the Right Hemisphere in Vision,"

Levy, J., "Psychological Implications of Bilateral Symmetry."

Eccles, J., ed., Brain and Conscious Experience
N.Y., Springer-Verlag, 1966

The papers of a neurological symposium, this volume contains R.W. Sperry's "Brain Bisection and Consciousness" together with an overview of Sperry's work of 1953 to 1964.

Edwards, Betty, Drawing on the Right Side of the Brain:
A Course Enhancing Creativity and Artistic Confidence
Los Angeles, J.P. Tarcher, 1979, 207p., bib., ind., illus.

The art-educator author is committed to integrating current knowledge of hemispheric specialization with the teaching of art, specifically drawing. She gives a number of drawing tasks which are designed to activate right-mode thinking, and trick left-mode thinking into submission and non-interference. Many illustrations and quotations are included.

Ferguson, Marilyn, The Brain Revolution
N.Y., Taplinger, 1973, 380p., bib., ind.

This book, written by the editor of the Brain/Mind Bulletin, explores altered states of consciousness, meditation, bio-feedback, hypnosis, drugs, dreams, pathologies, sensory deprivation and overload, trance learning, etc.

Pages 177-190 review hemispheric specialization. Chapter 20, "The Anatomy of Creativity," p. 285ff, explores the conjecturing brain's ability to make choices based on partial evidence.

Fincher, Jack, Human Intelligence
N.Y., G.P. Putnam's Sons, 1976, 512p., bib., ind.

As a journalist, Fincher relies heavily upon research papers in experimental psychology. After the description of the brain as a whole in Chapter 1, Chapter 2 focuses on the divided brain research of Sperry, et al., breaking the research into its findings on touch, sight, mental skills, and interaction of the two modes of thinking. Chapter 3 explores the relationship of imaging and language, Chapter 4 that of "Learning, Thinking and Creativity," and Chapter 5 is entitled "Athletics and Art." In it, Fincher counters the assumption that neither athletics nor art requires acts of intelligence, by relating examples and research that reveal a very high level intelligence - that of integrating functions - prevalent among athletes and artists.

The role of imaging in creative writing and music, the synthesis of emotion and feeling with the artistic vehicle, whether it is words, images, music, or movement, and the expression of the divine, are seen as deriving from the same means. This thesis is supported by a generous supply of citations and inspirations of athletes and artists. The remainder of the book deals with testing, social responses to intelligence, and some speculation on the future of intelligence.

Gardner, Howard, The Shattered Mind
N.Y., Vintage, 1974, 481p., ind.

While most of this book deals with persons' behavior following brain damage, and thus is more pertinent to psychologists than artists, Chapter 8, p. 291, "The Pathology of Art," explores the effect of brain damage on artists. Gardner gives several case histories of artists (pp. 303-333) who continued to work, with varying degrees of continuity and proficiencey, following cerebral lesions (stroke). Lovis Corinth, (1858-1925) sustained a severe right hemispheric stroke in 1911, but after initial depression, continued painting until his death. Illustrations are given of Corinth's work before and after the stroke, as are some examples of another painter and an architect. Evidence is that artists, better trained throughout the whole brain, make greater recovery following a stroke.

Gazzaniga, Michael S., The Bisected Brain
N.Y., Appleton-Century-Crofts, 1970, 172p., ind., ref.

This book provides an overview of what occurs when the corpus callosum, which is the transmitter between the two halves of the brain, is removed. It was such operations, undertaken in severe epileptics by neurosurgeon R.E. Myers, and psychologist R.W. Sperry to reduce the frequency and intensity of seizures, that provided the information that the hemispheres have separate but equally important cognitive systems. Gazzaniga describes those systems in detail.

Gazzaniga, M.S., and LeDoux, J.C., The Integrated Mind
N.Y., Plenum, 1978, 168p., ind., ref.

In this book, Gazzaniga turns to issues of interhemispheric communication; it is a complement to the above entry. Chapter 3 clarifies the facts from theories of cerebral lateralization and hemispheric specialization: fact - "each hemisphere is endowed with certain capacities that are either lacking or poorly represented in the other half-brain," (p.47); theory - "the hemispheres have come to be viewed as possessing unique, evolved cognitive styles . . ." (op.cit.).

Descriptions of experiments which clarify lateralized function from specialization, and show a high degree of integration in the latter, are offered. ". . . the cerebral hemispheres in man do not oppose each other but instead work together to maintain the integrity of mental functioning." (p.72) In following chapters, he addresses the nature of the brain as related to language, intelligence, imagery, and memory.

Goodman, Nelson, Perkins, David, Gardner, Howard, et al.,
Basic Abilities Required for Understanding and Creation in the Arts
Cambridge, MA, Harvard, 1972, 96p.

This is a report on some of the findings of Project Zero at Harvard University, a collaboration of philosophers, psychologists, artists, and art educators, in which the developmental processes for understanding and creating in the arts are studied. Chapter 3, part 2, "Brain Function, Linguistic Systems, and the Arts" reports Gardner's findings that the left hemisphere processes familiar information whereas the right hemisphere processes non-familiar. Goodman proposes that the right hemisphere initially processes all unfamiliar information, but as it becomes familiar, it is transferred to and subsequently handled by the left hemisphere.

Other sections address problem solving in the arts, and "Education in the Arts."

Hart, Leslie, How the Brain Works
N.Y., Basic Books, 1975, 257p., ind., bib., illus.

This is an overview of the whole brain, and how it works including hemispheric differences. It is written in plain, readable language.

Lee, Philip R., et al., Symposium on Consciousness, AAAS, 1974
N.Y., Viking, 1976, Penguin, 1977, 175p., bib.

Six papers explore the potential of the human mind. Each focuses on a speciality of the author relating to the synthesis of opposites or differences, such as mind-body, analytic-intuitive, eastern-western philosophies, mysticism-rationalism, etc., in order to tap latent potentialities of the human mind.

Chapter 3, by neurologist David Galin, explores the two modes of consciousness and hemispheric specialization.

McGuigan, Frank J., and Schoonover, R.A., eds., The Psychopathology of Thinking
N.Y., Academic, 1973, 551p., bib.

Chapter 6, pp. 209-227, contains R.W. Sperry's seminal paper, "Lateral Specialization of Cerebral Function in the Surgically Separated Hemispheres," in which Sperry's experiments with hemispheric differentiation are presented, together with his conclusions about the two modes of thinking. An edited transcript of the discussion which followed the presentation of this startling and pathfinding information is included.

McKim, Robert H., Experiences in Visual Thinking
Belmont, CA, Wadsworth, 1972, 171p., bib., ind., illus.

Interspersed throughout are challenges to think and problem-solve visually. Chapter 3, "Ambidextrous Thinking," acknowledges that the whole book deals with the integration of the two modes of thinking, or of analytical thinking with seeing.

There are many visual puzzles and tasks of potential interest and inspiration to the art educator. The book can be used as a workbook for one's own learning, or as a guide for teaching others. See also:

McKim, R.H., Thinking Visually, a Strategy Manual for Problem Solving
Belmont, CA, Lifetime Learning, 1980, 210p., bib., ind., illus.

Ornstein, Robert E., ed., The Nature of Human Consciousness: A Book of Readings
San Francisco, W.H. Freeman, 1968, 514p., ind., bib.

This is a collection of articles and papers which address the issue of consciousness, from William James and C.G. Jung to the explorers of human consciousness in the late 1960s. Section II, "Two Modes of Consciousness," contains six articles drawn from diverse sources: psychiatry, psychology, neurosurgery, anthropology, Chinese mysticism, philosophy, and science.

Psychoanalyst A.J. Deikman delineates two major modes of consciousness into active and receptive modes, and stresses that the receptive mode is an essential component of highest human capability. Neurologist M.S. Gazzaniga gives a lucid summary of the findings of Sperry et al., in the area of brain hemispheric function. J.E. Bogen focuses on the holistic functioning of the right brain.

A passage from the I Ching which identifies and defines the polarities of Ch'ien (the creative) which exists in time, not space, and K'un (the receptive) which exists in space, not time, is included.

Anthropologist D. Lee describes the Trobrianders of New Guinea as a right-hemisphere-dominant culture. Psychoanalyst G.W. Dornhoff focuses on semantics and how language of the right (left brain) has dominated that of the left (right brain) in our culture.

Other sections of the book deal with esoteric psychologies, Sufism, and "An extended concept of man."

Ornstein, Robert E., The Psychology of Consciousness
NY, Viking, 1972, 227p., ref., ind.

Ornstein's dismay at the limitations of analytic thinking and ordinary consciousness, pervades this book. He explores intuitive thinking and esoteric consciousness, and then brings the two modes of thinking together in a synthesis. Chapter 3, p. 49-74, describes hemispheric specialization. Techniques for shifting from one mode of thinking to the other are provided, and recommendations are made for integrating this flexibility of thinking in one's life. Ornstein is concerned more with poetry and dreams than with visual arts, but many ideas are applicable to visual thinking.

Penfield, Wilder, The Mystery of the Mind: A Critical Study of Consciousness
Princeton, NJ, Princeton, 1975, 123p., bib., ind.

This Canadian neurosurgeon was a pioneer in discoveries which led to the recognition of hemispheric differentiation in the human brain. In this book for a wide readership, he writes a series of essays and reminiscences of his long and fascinating career in discovering many previously unknown functions of the human brain. Having acquired such a knowledge of the brain in its many parts, he searched for a holistic comprehension of the mind. He finds it through intuition and hopes that his acknowledgement is sufficient validation for its existence.

Perkins, David, and Leondar, Barbara, eds., The Arts and Cognition
Baltimore, Johns Hopkins, 1977, 341p., bib., ind.

The articles which comprise this book were chosen to support the premise that the creation of art is a cognitive process. It aims to comprehend how works of art are made, and made sense of, and how people come to do both. Chapter 4, "Senses, Symbols, Operations: An Organization of Artistry," by Howard Gardner, explores the differences between 'operative' and 'figurative' cognition. These thought processes relate to scientific, left hemispheric, and artistic, right hemispheric; respectively, and are part of a taxonomy which Gardner feels is important if we are to discuss issues of artistic cognition coherently. Several other chapters address visual expression and communication.

Perkins, David, The Mind's Best Work
Cambridge, MA, Harvard, 1981, 314p., bib., ind.

This book explores invention, creativity, discovery, insight, search, fluency, mastery, heuristics, inquiry, talent, selection, and making - creatively written and illustrated. In Chapter 9, Perkins addresses two questions about "supposed hemispheric functions": "Is it so?" and "So what if it is?" (p.257) He offers a strong word of caution, that the evidence for exclusive functioning of one type or the other is non-existent, and that it is in the nature of polarities to seem more significant than they really are. "Understanding how intuitive and rational factors do the work of thinking requires recognizing their pervasive partnership . . . The mix of intuitive and rational factors in any human activity should be remembered." (p.261) "The right half of the brain can't with any confidence or cogency be said to house the intuitive, artistic, visual, or divergent faculties. It cannot be called the creative hemisphere. Nor, if it could, would be very much informed about creativity." (p.262)

Pines, Maya, The Brain Changers: Scientists and the New Mind Control
N.Y., Harcourt Brace Jovanovich, 1973, 248p., ind.

This provides an overview of brain research as it was happening in the 1960s and early 1970s. As a journalist, Pines has written for the layperson to make the complexities of the human brain as clear as possible.

Chapter 7, pp. 139-159, focuses on hemispheric specialization and dominance/subordination. Other chapters look at the essential qualities and alterability of language, memory, pleasure and pain, bio-feedback, mind-altering drugs, emotion, and violence.

Regelski, Thomas A., Arts Education and Brain Research
Reston, VA, Music Educators National Conference, 1978, 32p., bib.

This is a concise and informative pamphlet which identifies the 'new brain' and its differentiated functions; outlines the learning process in light of the latest thinking, giving particular attention to aesthetic learning; and suggests future directions for research in art education as related to brain research.

Rosenfeld, Albert, ed., Mind and Supermind
N.Y., Holt Rinehart & Winston, 1977, 283p., bib., ind.

Three special issues of Saturday Review: "Mind and Supermind," February 22, 1975; "Inside the Brain," August 9, 1975, and "The Psychotherapy Jungle," February 21, 1976, have been combined to form this book. "Left-Brain, Right-Brain" by R.W. Sperry is included, pp. 124-136.

Samuels, Mike and Nancy, Seeing with the Mind's Eye: The History, Techniques, and Uses of Visualization
N.Y., Random House, 1975, 331p., ind.

The many varieties of uses for visualization as a right mode activity, are explored. These include mysticism, rituals, healing, memory, hypnagogic states, dreams, hallucinations, and symbols. Hemispheric specialization is mentioned only in passing, yet it is acknowledged that most, if not all, visualization is a right mode activity. A number of procedures to activate and tap the resources of right mode thinking are given.

Springer, Sally P., and Deutsch, Georg, Left Brain, Right Brain
San Francisco, W.H. Freeman, 1981, 243p., ref., ind.

Psychologist Springer and neurophysiologist Deutsch collaborate to give a clinical view of brain asymmetry which is accessible and readable for the non-clinician. They separate established facts from the many speculations that abound, giving a thorough presentation of the history of the research findings in brain-damaged, split-brain, and normal subjects, and then consider the special topics of handedness, in which no significant differences in creativity have been found; gender differences in brain asymmetry, in which there are no conclusive major differences; and the development of asymmetry.

They then take on speculations: two brains, two minds?, cultural differences in hemisphericity, and discuss education and the right brain with an evolutionary perspective. An appendix, "Functional Neuroanatomy and Clinical Disorders, A Brief Review," describes some classic dysfunctions arising from brain injury.

There is little that is specifically pertinent to art, yet this book is the most thorough and objective overview of the left-brain, right-brain research which I encountered in the research for this bibliography.

Virshup, Evelyn, A Compilation of Feelings by Right Brain People in a Left Brain World
Los Angeles, Guild of Tutors, 1970, 95p., bib., ind., illus.

An art therapist working with drug addicts describes her techniques for revealing feelings through art, and illustrates them with drawings and words by her clients. Chapter 4, "Drawing Together" is about "The fine artist and the right and left brain." She suggests that the concepts of left and right mode thinking "may give some of us permission to stop evaluating ourselves in logical analytical ways and to accept and start developing those nonlogical parts of our selves, which are truly necessary for the artist and the creative process in all of us." (p.53) She identifies artists whose works are dominated by left mode thinking: Mondrian, Seurat, Pevsner, Albers, etc., and right mode: Kline, deKooning, Hoffman, Gorky, etc., and suggests that one responds more favorably to work which is more like one's own dominant mode of thinking. (pp.53-59)

CHAPTER III

ARTICLES

Methodology

Only articles that have been published in professional journals have been included. The many articles that have appeared in recent years in the popular press tend to communicate biases, enthusiasms, and simplifications which can preclude an objective view of the topic. Professional journal articles are the sources of information on developing theories and findings, and because of their relative brevity (compared to a textbook), they can be comprehended by a motivated reader. For the most part, the scope applied to the book selection applies here, but with some widening to include the most closely related peripheral areas.

Because Sperry's catalytic paper was published in 1963, 1960 was set as a cut-off date for researching pertinent indices. The data banks utilized go back to 1966.

In the Art-Index, there is no heading for "Brain," so those of "Creation/Creativity," "Perception," and "Thought/Thinking" were researched for titles about brain hemispheric differences. Not one article was found.

The Education Index was more generous, having the heading, "Brain." This topic (general), and the subheadings, "Localization of Functions," and "Research," were searched for titles that were pertinent to art and art education.

The Cummulated Index Medicus heading on "Brain" brought such an overwhelming abundance of traumas, pathologies, dysfunctions, under the subheadings of "Hemispheres and Laterality," that the heading, "Art," was searched. Concerns with art therapy, handedness, and perception were found, all of which were judged to be beyond the scope of this paper.

As a largely behavioral topic, Psychological Abstracts provided not only more titles, but abstracts for books and articles that were otherwise unobtainable. With the related computerized bibliographic literature search,

Psyc-Info, I interfaced "Cerebral Dominance" with "Art" and "Art-in-process." This procedure yielded some relevant titles.

A computer search with Educational Resources Information Center (ERIC) was also made by interfacing "Cerebral Dominance" with "Art" and "Art-education." This too provided some pertinent titles. And finally, bibliographies and reference sections of the books and articles researched proved to be the most generous resource.

Having been as thorough as possible in the search for relevant articles, it was again I who selected the titles to be included. Because many of the articles have been assimilated and included in the books that were reviewed in Part I, abstracts are provided only where either the title does not reveal the nature of the substance of the article, or where the topic is too recent to have reached a wider dissemination through inclusion in books.

Citations given are in this order: Volume number, Year or date, Issue number, Page or pages; as included.

Bennett, J.E., and Trinder, J., "Hemispheric Laterality and Cognitive Style Associated with Transcendental Meditation" Psycho-Physiology, 1977, 14, 293-296.

During transcendental meditation, both hemispheres are symmetrical with respect to the distribution of alpha wave activity, while during tasks, the alpha distribution becomes more asymmetrical in TM subjects compared with controls.

Bogen, Joseph E., "Hemispheric specificity, complementarity, and self-referential mapping," Proceedings of the Society for Neuroscience, 1973, 3, 413

_____"The Other Side of the Brain I: Dysgraphia and Dyscopia Following Cerebral Commissurotomy," Bull. of the Los Angeles Neurological Society, 34, 1969, 73-105

_____"The Other Side of the Brain II: An Appositional Mind," Ibid., 135-162

_____"The Other side of the Brain III," Ibid., 191-203

_____"Split-Brain Research and Education," Brain/Mind Bulletin, 1, 12/15/75, 3, 1-2

_____"The Other Side of the Brain VII: Some Educational Aspects of Hemispheric Specialization," UCLA Educator, 17, 1975, 24-32

_____, and DeZure, R., et al., "The Other Side of the Brain IV: The A/P Ratio," Bull. of the Los Angeles Neurological Society 1972, 49-61

_____, and Fischer, E.D., et al., "Cerebral Commissurotomy: A Second Case Report" J. of the American Medical Association, 1965, 194, 1328-9

_____, and Gazzaniga, M.S., "Cerebral Commissurotomy in Man: Minor Hemisphere Dominance for Certain Visuospatial Functions," J. of Neurosurgery, 23, 1965, 394-9

Botkin, James W., et al., "Towards More Effective Teaching and Learning: What can Research in the Brain Sciences Contribute? A Survey of Some Recent Research Efforts and Their Implications for Education," ERIC, 1980, ED 200402

This report describes some current research which links selected aspects of brain research to selected issues in education. These issue areas include: (1) the relationship between neurophysiology and cognition; (2) the implications of cerebral lateralization for creativity, imagery, and art education; (3) sex differences in brain functioning; (4) nutrition and learning; (5) new methods in analyzing learning disibilities; and (6) implications for a newly emerging concept of holistic education. (Abstract from ERIC)

Chemtob, Claude M., "Paradoxical Complementarity in the Esthetic Preferences of the Cerebral Hemispheres; An Exploratory Study," Perceptual & Motor Skills, 48, 6/79, 3-1, 799-806

Results show significant differences in the consistency of intrahemispheric and interhemispheric preferences, a finding which indicated reliable differences in the aesthetic choices associated with each hemisphere. Given an initial like or dislike of stimuli by the hemisphere first activated, [by tachistoscopic exposure to separate visual fields] the other hemisphere will exhibit preferences in the opposite direction. This suggests a process of paradoxical complementarity between the hemispheres in which the preferences of the hemispheres are antithetical but not fixed. (Abstract from PsycInfo)

Corballis, Michael C., "Laterality and Myth," American Psychologist 35, 3/80, 3, 284-95

Corballis traces the myths from ancient times that have been classified with right and left: male and female, good and evil, day and night, straight and crooked, etc., and cautions us not to perpetuate the myths by

jumping to conclusions from recent research: "This transcendental conception of hemispheric duality is inspired more by age-old myths about left and right than by the empirical evidence." (p.287) "There is also little support for the idea that the right hemisphere has a special role in creativity." (p.288)

Deikman, A.J., "Bimodal Consciousness," Archives of General Psychiatry, 1971, 25, 481-9

Doerr, Susan L., "Conjugate Lateral Eye Movement, Cerebral Dominance, and the Figural Creativity Factors of Fluency, Flexibility, Originality, and Elaboration," Studies in Art Education, 21, 1980, 3, 5-11

This study explored general relationships between figural creativity, as measured by the Torrance Tests of Creative Thinking, and cerebral dominance, as indentified by the conjugate lateral eye movement (CLEM) interview procedure. [See Gur, R.E. below.] Subjects were 175 adults. Results indicated no significant differences in figural creativity due to brain dominance type or sex. (Abstract from ERIC, 1980, EJ 229287)

Dorethy, Rex, and Reeves, Dan, "Mental Functioning, perceptual Differentiation, Personality, and Achievement among Art and Non-Art Majors," Studies in Art Education, 20, 1979, 2, 52-63

College art majors, art education majors, and non-art majors were compared on measures of brain hemisphere dominance, general intelligence brain functioning, visual perceptual differentiation, grade point average, flexibility-rigidity, and personal-social adjustment. (Abstract from ERIC, 1979, EJ 207576)

Doyle, J.C., Ornstein, R., and Galin, D., "Lateral Specialization of Cognitive Mode II: EEG Frequencey Analysis," Psychophysiology 1974, 11, 567-578

Durnford, M. and Kimura, D., "Right Hemisphere Specialization for Depth Perception Reflected in Visual Field Differences," Nature, 1971, 231, 394-5

Dusewicz, R.A., "Lateral dominance and Creativeness," Perceptual and Motor Skills, 1968, 27, 826

Edwards, B. " 'Right-Brain' Focus Powerful Teaching Tool for Art," Brain/Mind Bulletin, 3, 12/19/77, 3, 3

Ferguson, Marilyn, ed., Brain/Mind Bulletin, Los Angeles, Los Angeles, Interface, semi-monthly, 1975 to present

This publication reports regularly on developments in the areas of creativity and neurological discoveries. The articles are drawn from professional researchers and journals, and are presented in a concise and readable form for the intelligent lay reader. Information for obtaining the original speech or article is given.

Foster, Suzanne, "Hemisphere Dominance in the Art Process," Art Education, Feb. 1977, 28-9

The author recommends caution in assuming the right hemisphere is most relevant to art creation. She feels the findings do have implications for teaching, learning, research in art education, but calls for more research on dominance with healthy normal brains as differentiated from the research reported by Ornstein in The Psychology of Consciousness, and Gardner in The Shattered Mind.

Frumkin, L.R., and Pagano, R.R., "Effect of Transcendental Meditation on Iconic Memory," Biofeedback and Self Regulation, 1, 1979, 4, 313-22

Gainer, R.S., and Gainer, H., "Educating Both Halves of the Brain: Fact or Fancy," Art Education, Sept. 77, 20-2

This visual arts specialist and neurochemist claim that subject matter cannot be compartmentalized into cognitive and affective realms of learning; that the arts involve thinking that is ordering and abstracting just as the sciences involve intuition and creatvity. They cite neurological evidence that the brain works as a unified structure, and call for an openness to discoveries in other fields, but not to accept the claims of Ornstein, et al., that we've been educating only one side of the brain, without critical evaluation and a broad perspective.

Galaburda, A.M., et al., "Right-Left Asymmetries in the Brain," Science, 199, 2/78, 14, 852-6

Three neurologists and a radiologist report on their research into the degree of brain asymmetry in left-handed persons compared to right-handed persons, and find, in general, less asymmetry, more integration among the left-handed.

Galin, D., "Implications for Psychiatry of Left and Right Cerebral Specialization," Archives of General Psychiatry, 1974, 31, 572-83

_____,and Ornstein, R.; "Lateral specialization of cognitive Mode: An EEG Study," Psychophysiology, 9, 1972, 4, 412-8

Gardner, H., "What We Know and Don't Know About the Two Halves of the Brain," J. of Aesthetic Education, 12, 1/78, 113-9

Gardner suggests that split-brain research may foretell changes in education, but recommends that because research is incomplete and scientifically inconclusive, we should move cautiously and wait for further investigation.

Garrett, S.V., "Putting Our Whole Brain to Use: A Fresh Look at the Creative Process," J. Creative Behavior, 10, 4, 239-49

This article "discusses recent research which has clarified the nature of the creative process, including such topics as split-brain studies, convergent and divergent thinking, and art and play activities and their effects on learning. Implications for educational practice and theory are considered." (Abstract from Psyc-Info) It is a call to awareness of the two modes of thinking, and for the inclusion of more intuitive, holistic experiences in the classroom in order to right the balance with analytic and linguistic learning activities.

Gazzaniga, M.S., "Recent Research on Hemispheric Lateralization of the Human Brain: Review of the Split-Brain," Educator 5/75, 17, 9-12

_____, Bogen, J.E., and Sperry, R.W., "Observations on Visual Perception after Disconnection of the cerebral Hemispheres in Man," Brain, 88, 1965, 221-36

_____, and Young, E.D., "Effects of Commissurotomy on the Processing of increasing Visual Information," Experimental-Brain Research, 1967, 3, 368-71

Geffen, G., Bradshaw, J.L., and Wallace, G., "Interhemispheric Effects on Reaction Time to Verbal and Nonverbal Visual Stimuli," J. of Experimental Psychology, 87, 1971, 415-22

Gibson, W., "Pioneers in Localization of Brain Function," J. of American Medical Association, 180, 1962, 944-51

Guilford, J.P., "Creative Thinking and Problem Solving," Education Digest, 1964, 29, 29-31

This is the article where the concepts of convergent and divergent thinking were presented as central to creative thought and action.

Gur, R.E., "Conjugate Lateral Eye Movements as an Index of Hemisphericity," J. of Personality and Social Psychology, 1975, 31, 751-7

This reports findings that leftward eye movement connotes visuospatial thinking, and rightward eye movement accompanies verbal thinking.

Hardyck, C., and Haapanen, R., "Educating Both Halves of the Brain: Educational Breakthrough or Neuromythology?," J. of School Psychology, 17, fall 1979, 3, 219-30

These educational psychologists take a fairly technical look at the split-brain research, and think that commissurotomy patients are not a suitable group on which to base generalizations about brain function in normal persons; that left-right differences in thinking in normal persons is far from conclusive; and conclude that there is no scientific basis for reorganization of curricula, teaching, or testing programs.

Hunter, M., "Right Brained Kids in Left Brained Schools," The Education Digest, Feb. 1977, 8-10, excerpted from Today's Education, LXV, 1976, 45-49

The author suggests that kids not doing well in school may be the fault of educators rather than the kids, in that we have not acknowledged the validity of right mode thinking. She feels that hemispheric research findings mandate integrative learning opportunities, that teachers learn how to present material in both thinking modes, and that teachers "increase students' facility--the use of each hemisphere singly and in concert." (p.9) To do this, she recommends that teachers present all material both verbally and viusospatially. While not stated, the kids in question seem to be elementary school age.

Hutt, C., "Cerebral Asymmetry and Hemispheric Specialization: Some Implications of Sex Differences," International J. of Behavioral Development, 2, 1, 73-86

Katz, A.N., "Creativity and the Right Cerebral Hemisphere: Towards a Physiologically Based Theory of Creativity," J. of Creative Behavior, 12, 1978, 4, 253-64

Kimura, D., "Dual Functional Asymmetry of the Brain in Visual Perception and Memory," Neuropsychologia, 4, 1966, 275-85

_____"Spatial Localization in Left and Right Visual Fields," Canadian J. of Psychology, 23, 1969, 445-58

Kinsbourne, M., "Eye and Head Turning Indicates Cerebral Lateralization," Science, 176, 1972, 539-41

Kocel, K., et al., "Lateral Eye Movement and Cognitive Mode," Psychonomic Science, 27, 1972, 223-4

Krashen, S.P., "The Left Hemisphere," Educator, May 1975, 17-23

Leaffer, T., "Left-Brain — Right-Brain: Domination or Cooperation," J. Creative Behavior, 15, 4, 242-50

This human development researcher and educator seeks to facilitate cooperative interaction between verbal and non-verbal skills in students and colleagues. An "adult" exercise is described which uses an advertisement that combines verbal and visual messages.

LeCompt, N., and Rush, J.C., "The Jack Sprat Syndrome: Can Split-Brain Theory Improve Education by Including the Arts?," J. of Education, 163, fall 1981, 335-43

This article is an overall look at the issue of various split-brain theories as interpreted as a call to arms for the arts. It gives a concise history of the neurological developments of split-brain research, the implications for education, its application to creative teaching, and concludes that using split-brain theory to rationalize changes in educational curricula is still unjustified. "However, using the idea of multiple ways of knowing, suggested by this research, to help our students expand their abilities is legitimate and commendable." (p.340) The authors have found that "awareness of lateral asymmetry . . . has created an educational environment that is encouraging educators to integrate art into conventional curricula, not as an esoteric studio activity, but as a cognitive learning discipline." (p.341) Good bibliography.

LeDoux, J.E., and Risee, G., et al., "Cognition and Commissurotomy," Brain, 100, 1977, 87-104

_____, and Wilson, D.H., et al., "A Divided Mind: Observations on the Conscious Properties of the Separated Hemispheres," Annals of Neurology 2, 1977, 417-421

Levy, Jerre, "Information Processing and Higher Psychological Functions in the Disconnected Hemispheres of Human Commissurotomy Patients," Thesis, California Institute of Technology, 1970

_____, "Possible Basis for the Evolution of Lateral Specialization in the Human Brain," Nature, 224, 1969, 614-5

_____, "Lateral Dominance and Aesthetic Preference," Neuropsychologia, 1976, 14, 431-45

Levy confirms the empirical observations of Heinrich Wöfflin, that there is a preference for the left visual field in right-handed persons so that the center of interest should be in the right field of a picture in order to balance that preference. She also proves that the scanning from left to right is related more to hemispheric dominance than to conditioning by reading.

_____, and Levy, J.M., "Human Lateralization from Head to Foot: Sex-Related Factors," Science, 1978, 200, 1291-2

_____, Nebes, R.D., and Sperry, R.W., "Expressive language in the surgically separated minor hemisphere," Cortex, 1971, 7, 48-59

_____, and Sperry, R.W., "Differential Perceptual capacities in Major and Minor Hemispheres," Proceedings of the National Academy of Science, 61, 1968, 1151

_____, and Trevarthen, C., "Metacontrol of Hemispheric Function in Human Split Brain Patients," J. of Experimental Psychology: Human Perception and Performance, 2, 1976, 299-312

MacKinnon, C., "Implications of Right Brain Research on Curriculum Development," ERIC, 1981, ED 211519

The author discusses the possibilities for developing right brain thinking as an integrative part of education, and recommends curricular activities to that end.

Maslow, A.H., "Two Kinds of Cognition and Their Integration," General Semantics Bulletin, 1957, 20, 17-22

McGlone, J., and Kertesz, A., "Sex Differences in Cerebral Processing of Visuospatial Tasks," Cortex, 1973, 9, 313-320

Metallinos, N. "Viewers' Perception of TV Images: Empirical Research and Television Aesthetics," ERIC, 1978, ED 168063

To relate scientific evidence with subjective interpretations relevant to the construction and appreciation of visual images, this paper reviews the

literature pertinent to the processes involving the perception of visual images, the distinct functions of the left and right hemispheres of the human brain in recording and interpreting visual data, the psysiological properties of television images, and the compositional factors that determine the effective structure of television images. The paper concludes that the construction of significant theories on television aesthetics, insofar as viewers' perception, interpretation, and response are concerned, should be based on empirical research that relates scientific findings (studies on visual perception, neurology, and physiology) with subjective interpretations (studies on visual communication and art composition). Such research, it contends, will bridge the gap between factual information and intuitive choices and will enhance the field of visual communication. (Author's abstract in ERIC)

Myers, R.E., and Sperry, R.W., "Interhemispheric Communication Through the Corpus Callosum, Mnemonic Carry-Over Between the Hemispheres," Archives of Neurology and Psychiatry, 80, 1958, 298-303

Nebes, R.D., "Dominance of the Minor Hemisphere in Commissurotomized Man in a Test of Figural Unification," Brain, 95, 1972-, 633-8

_____, "Hemispheric Specialization in Commissurotomized Man," Psychologial Bulletin, 1974, 81, 1-14

_____, "Man's so-called 'Minor' Hemisphere," Educator, May 1975, 13-16

Ornstein, R., "The Split and Whole Brain," Human Nature 1, 1978, 76-83

Pagano, R.R., and Frumkin, L.E., "The Effect of Transcendental Meditation on Right Hemispheric Functioning," Biofeedback-and-Self-Regulation, 1977, 2, 407-15

Pizzat, J., "I'm a Right Brained Person, Why Me God?," Art Education, March 1979, 10-11

An art educator and tennis player offers a subjective account of what it is like to have a right hemispheric dominance, and calls for more responsible research and greater understanding of those who are struggling to deal with a civilization that is more concerned with left hemispheric thought and activity.

Note: Two other articles in this issue: "Can the Arts Teach Thinking: A Look at Artistic Conceptual Behavior," by J.C. Rush, and "The brain - Is Half an Education Better than None?," by B. Vanetta, address the relevance of art education to educating the whole person.

Prince, G., "Putting the Other Half of the Brain to Work," Training, Nov. 1978

Reynolds, C.R., Riegel, T., and Torrance, E.P., "A Bibliography for Interdisciplinary Research on Lateral Cerebral Specialization and Interhemispheric Integration and Processing of Information," Gifted Child Quarterly, 21, winter 1977, 574-585

About 50 of the over 300 titles were found to be relevant to this paper, and are listed herein. The remainder are highly specialized and deal with handedness, reading disabilities, pathologies of the brain, eye movement, and other perceptual manifestations, motor skills, linguistic development etc. No abstracts are given.

Riegel, T., "Cognitive Style as Indicated by Lateralization, and its Relationship to Creativity," unpublished pilot study, University of Georgia, Athens, Georgia, 1975

Rossi, E., "The Cerebral Hemispheres in Analytical Psychology," Journal of Analytic Psychology, 22, 1/77, 1, 32-51

Rossi outlines some of the possible relations between recent experimental research on the specialized functions of the cerebral hemispheres and a number of Jung's major concepts, hypothesizing about how much of Jung's work could be understood as an exploration of the different modes of hemispheric functioning and their integration. Jung appears to have recognized a wide range of psychological functions as basic to a balanced way of psychic life. Many of these can now be understood as specialized functions of the left or right hemisphere. The integration of these specialized hemispheric processes may be the neuropsychological foundation of Jung's concept of the transcendent function and the basis of many activities in religion, art, and psychology. (Abstract from Psyc-Info)

Rothenberg, A., "Homospatial Thinking in Creativity," Archives of General Psychiatry, 33, 1976, 1, 17-26

Rubenzer, R., "The Role of the Right Hemisphere in Learning and Creativity Implications for Enhancing Problem Solving Ability," Gifted Child Quarterly, 23, spring 1979, 1, 78-100

This reviews theoretical and research literature regarding right-hemisphere processing and modes of cognitive functioning. It is suggested that the right hemisphere is dominant in the interpretation and retention of

nonverbal visual and auditory patterns; in processing "artistic subjects" such as music, art, dance, and physical education; in tasks that require intuitive, simultaneous, and divergent thinking; in affective responses; and in creative thinking. It is also suggested that right-hemisphere functioning is dominant during certain organismic states (e.g., relaxation). On the basis of the findings of the cited literature, the author offers a psychophysiological model for promoting right-hemisphere functioning and problem-solving abilities. This might be accomplished through systematic relaxation and the conscious elicitation of physiological states that are supposed to take place during each of 4 stages that lead to problem solving. (Abstract from Psyc-Info)

Sage, W., "The Split Brain Lab," Human Behavior, 1976, 6, 5, 24-28

Samples, R.E., "Are You Teaching Only One Side of the Brain?," Learning, 3, 1975, 6, 24-30

_____, "New Perspectives - On Art Education," Thrust for Educational Leadership, 7, Jan. 1978, 3, 13-4, 31

Sperry, R.W., "The Great Cerebral Commissure," Scientific American, 1964, 210, 42-54

_____, "Hemisphere Deconnection and Unity in Conscious Awareness," American Psychologist, 23, 1968, 723-33

_____, "Hemispheric Specialization of Faculties in the Brain of Man," Claremont Reading Conference 36th Yearbook, M.P. Douglas, ed., Claremont, CA, 1972, 126-36

_____, "A Modified Concept of Consciousness," Psychological Review, 1969, 76, 532-6

Trotter, N.J., "The Other Hemisphere," Science News, 1976, 109, 218-20

Uhrbrock, R.S., "Laterality in Art," J. of Aesthetics and Art Critcism, 32, 1973, 27-35

This examines the extent to which right- and left-sidedness can be recognized in the work of sculptors and painters, with emphasis on depictions of the madonna and child. Laterality factors in the design of coins, medallions, and stamps are also considered. (Abstract from Psyc-Info)

Virshup, E., "Art and the Right Hemisphere," Art Education, Nov. 1976, 14-15

Derived from Jungian psychology that we have dominant or superior functions, and inferior functions, for dealing with the world: intellectual, sensory, feeling, intuitive; this art therapist suggests we develop our inferior functions through awareness, openness, and willingness to explore.

That these functions are being corroborated physiologically, may be important in our willingness to accept them and see through another's eyes. The author feels it is especially important for art teachers to accept the range of solutions from students to a given problem.

Wenger, W., "Creative Creativity: Some Strategies for Developing Specific Areas of the Brain and Working Both Sides Together," J. of Creative Behavior, 15, 2, 77-89

A psychologist discovers that what art and art history teachers have been doing, combining visual displays with verbal commentary, is a highly effective way of learning. It might be applied to many other learning experiences.

White, M.J., "Laterality Differences in Perception: A Review," Psychological Bulletin, 72, 1969, 387-405

Wittrock, M., ed., "Education and the Hemispheric Process of the Brain," Educator, May 1975, 17, 1-43

Youngblood, M.S., "The Hemispherality Wagon Leaves Laterality Station at 12:45 for Art Superiority Land," Studies in Art Education, 21, 1979, 1, 44-9

The author suggests that art educators are crowding on this wagon much the way they did on the wagons of "self-expresstion," "creativity," "process-product," etc. He points out that "research methods used to determine lateralization of brain function cannot indicate whether the physiological character of brain function is visual or verbal." (p.45) He contends that speaking about visual or verbal processing pertains only to the product of the thought process, not to the process itself.

_____, "Hemispheric Amphigory," Art Education, Jul 1981, 9-11

"Amphigory" means nonsense, and that is what Youngblood thinks of the left brain - right brain bandwagon. He highlights evidence of the

interactivity of the hemispheres of the brain for all human activity, and calls for a refraining from adopting the notion of separate roles for the hemispheres of the brain.

Zangwill, O.L., "Thought and the Brain," British J. of Psychology, 1976, 67, 301-14

Zangwell reports that the effect of lesions of the right hemisphere on the work of professional painters is not nearly so crippling as one would expect if the right hemisphere were crucial to artistic creativity, and concludes, "the right hemisphere is by no means as vital to artistic expression as is the left to literary creation." (p.309)

CONCLUDING COMMENTS

I think that the definitive work on the importance of brain hemispheric research for the creating and teaching of art has yet to be written. It is hoped that the foregoing bibliography will have brought the topic forth for closer consideration, and will inspire artists and art educators to become more knowledgeable about the interrelationship between cognitive processes and the creation of art.

The potential and rationale for curricular improvement at all levels of education is relatively undeveloped, and requires further attention. One thing that has become clear to me, despite Kipling's celebration (page 1), is that we no longer will be served by thinking of the two sides of our head as separate. As we become informed, integration and harmony are within reach.

However, as the need arises, we can choose to clarify and separate our modes of thinking in order to provide balance between the sequential and holistic in our lives; or to better serve our muse:

I felt a Cleaving in my Mind -
As if my Brain had split -
I tried to match it - Seam by Seam -
But could not make them fit.

The thought behind, I strove to join
Unto the thought before -
But Sequence ravelled out of Sound
Like balls - upon the Floor.

- Emily Dickinson[10]
c. 1864

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[10]Thomas H. Johnson, ed., The Complete Poems of Emily Dickinson, New York, Little Brown, 1960, # 937

APPENDIX

The following books were considered, but found to be beyond the scope of the foregoing bibliography. As peripherally related, they might be of use to the interested reader.

Brown, Jason, Mind, Brain, and Consciousness: The Neurophysiology of Cognition, NY, Academic, 1977

Pathological disorders.

Bruner, Jerome S., On Knowing: Essays for the Left Hand
Cambridge, MA, Belknap/Harvard, 1963, 165p.

This group of essays explores the roles of intuition, emotion, and spontaneity in the process of coming to know, and helping others to know. Essays entitled "The Conditions of Creativity," and "Art as a Mode of Knowing," may be of interest to art educators. Written prior to publication of the major breakthroughs in brain hemispheric differentiation, it is interesting to see how sensitive and knowledgeable this educator/epistomologist was to our having two modes of thinking. He bemoans the little regard our society and educational system hold for "combinatorial products of metaphorical activity." (p.4)

Collier, Graham, Art and the Creative Consciousness
Englewood Cliffs, NJ, Prentice Hall, 1972
212p., illus., bib.

While multiple ways of thinking are covered, hemispheric differentiation is not among them.

Corballis, Michael C., and Beale, Ivan L., The Psychology of Left and Right, Hillsdale, NJ, Lawrence Erlbaum, 1976,
227p., ind., ref.

This book is concerned primarily with handedness and cerebral laterality: how one tells left from right. This concern leads to symmetries, and specifically the role of bilateral, or mirror, symmetry in visual perception, and as manifest in art and design.

Davidson, Julian M., and Richard, J., eds., The Psychobiology of Consciousness, N.Y., Plenum, 1980, 489p., ind., ref.

Dimond, S.J., and Blizzard, D.A., eds., Evolution and Lateralization of the Brain, N.Y., Academy of Sciences, 1977, 501p., illus.

Papers from a conference held in New York in 1976, report on the research, with both humans and animals, that endeavors to understand the asymmetries that abound within our outwardly symmetrical bodies.

Eccles, John, The Brain and Unity of Conscious Experience Cambridge, England, Cambridge U., 1965

In this lecture, Eccles claimed that the right hemisphere cannot really think as it lacks the world of language, thought, and culture, all of which are uniquely human and essential to any idea of mind. (!)

Ehrenzweig, Anton, The Psychoanalysis of Artistic Vision and Hearing: An Introduction to Theory of Unconscious Perception, N.Y., George Braziller, 1965, 1953, 272p., ind.

Written prior to discoveries of hemispheric differentiation, this does not address that issue. Moreover, the author does not acknowledge a different mode ot thinking for artistic vision, but attributes much of what an artist does to the functionings of the unconscious as defined by Freud.

Eisner, Elliott W., ed., Educating Artistic Vision NY, MacMillan 1972, 306p., ind.

Providing theories of art education which have evolved from curriculum development in California since 1967, Eisner addresses how "people develop their ability to respond to and create visual form." (p.v) He sees a dichotomy between head and hand which the art educator must resolve. How artistic learning occurs is outlined: the educability of perceptual processes, the learning of skills in handling materials, and development of the ability ot visualize.

Eisner deals with the cognitive-perceptual complexity from a theoretical point of view that is influenced by Gestalt and developmental psychology. Curricular recommendations are made, and directions toward a synthesizing and integrative approach to art education with all learning is presented.

Ettinger, E.G., ed., Functions of the Corpus Callosum Boston, Little Brown, 1975

Franck, Frederick, The Awakened Eye
N.Y., Vintage, 1979, 147p. illus.

_____, The Zen of Seeing, N.Y., Vintage, 1973, 135p., illus.

The basic concept behind the Zen of seeing, and the awakened eye is an integration of thought and perception, and the transformation of vision.

Harnad, Steven, et al., eds., Lateralization in the Nervous System,
N.Y., Academic, 1977, 538p., illus.

This is a collection of papers reporting research on various asymmetrical developments and manifestations of the nervous system.

Hilgard, Ernest R., Divided Consciousness: Multiple Controls in Human Thought and Action,
N.Y., Wiley-Interscience, 1977, 300p., ind., bib.

This book is concerned with hypnosis and the pathology of divided consciousness, psychosis, etc.

Jaynes, Julian, The Origin of Consciousness in the Breakdown of the Bicameral Mind
Boston, Houghton Mifflin, 1976, 467p., ind.

In this search for the origins of consciousness, or self-awareness, in human history, Jaynes speculates also upon the evolution of brain asymmetry.

Kandinsky, Wassily, Concerning the Spiritual in Art
N.Y., Doubleday, 1959, Dover, 1977, 57p.
Originally published in 1914

Kandinsky speaks of the melodic and symphonic in art in the process of making art. These appear to be the linear and holistic respectively.

Kepes, Gyorgy, ed., Education of Vision
N.Y., George Braziller, 1965, 233p.

Many of the essays contained herein touch on the integration of thinking and perception.

Kinsbourne, Marcel, ed., Asymmetrical Function of the Brain
Cambridge, Cambridge, 1978, 581p.

While neurological in focus, the section, "Studies of Behavior Asymmetry," includes some examples from art and art education.

_____, ed., Cerebral Function Symposium: Third Coronado, 1971
Springfield, IL, C.C. Thomas, 1974, 300p., bib.

_____, and Smith, W.C., Hemispheric Disconnection and Cerebral Function, Springfield, IL, C.C. Thomas, 1974

MacLean, Paul D., A Triune Concept of the Brain and Behavior
Toronto, U. of Toronto, 1973, 165p., bib.

The evolution of the brain is traced, giving three areas named for the time of their development: reptilian, paleomammalian, and neomammalian. The concept that the whole is greater than the sum of its parts in the human brain, is presented.

Mandler, George, Mind and Emotion
N.Y., John Wiley & Sons, 1975, 280, bib., ind.

The interrelationship between learning and emotion is thoroughly investigated.

Masters, Robert, and Houston, Jean, The Varieties of Psychedelic Experience, N.Y., Holt Rinehart & Winston, 1966, 326p. notes

It is conjectured that what psychotropic drugs do is bypass the left-hemispheric sentinel, and give free rein to right-hemispheric visions.

McFee, June, Preparation for Art
San Francisco, Wadsworth, 1961, 341p., ind., glossary

A theory of art education that integrates cultural anthropology and psychology research with the practice of teaching art is aimed at elementary school art teachers.

Nicolaides, Kimon, The Natural Way to Draw
Boston, Houghton Mifflin, 1941, 221p.

Nicolaides' exercises engage an integration of the two modes of thinking, and nurture that integration through a thoughtful, perceptive, and natural way of drawing. He calls for utilizing all the senses for "correct observation."

Oatley, Keith, Perceptions and Representations: The Theoretical Bases of Brain Research and Psychology
N.Y., Free/MacMillan, 1978, 262p., bib., ind.

This veteran perception theorist reflects on the nature of perception in light of recent brain research. Hemispheric specialization is only briefly mentioned.

Orme-Johnson, D., and Wallace, R.K., et al., eds.
Longitudinal Effects of the Transcendental Meditation: Sidhi Program on EEG Coherence, Creativity, Intelligence and Moral Reasoning
Fairfield, IA, Maharishi International U., 1980

Using a study and control group, a four-month TM-Sidhi course was found to have produced beneficial changes in hemispheric coherence and creativity.

Pearce, Joseph Chilton, Magical Child
N.Y., E.P. Dutton, 1977, 257p., bib., ind.

"The magical child is one whose ability is his/her focus and who does not lose him/herself to content or memory." (p.215) Pearce "cringes at the thought of incorporating right brain curricula," (p.xv) believing that the compulsion of children to play and fantasize is universal and should not be structured. (ibid.)

It was a reference to this statement in another book that led me to read Magical Child in search for an anti-right-brain position. In fact, Pearce's position is supportive of providing optimal educational opportunities for all students, and the statement was made in reaction to the fear that educators would try to separate teaching methods into rigid categories.

Pompeiano, O., and Ajmone Marsan, C., eds., Brain Mechanisms of Perceptual Awareness and Purposeful Behavior
V. 8 of International Brain Research Organization Monograph Series. N.Y., Raven, 1981, 494p., ind.,

Papers presented at a symposium in Pisa, Italy, in 1980. All represent the forefront of neurological research, and thus are technical. Topics of processing visual information, the physics of visual perception, and selective attention are included, all of which address issues of hemispheric differentiation and communication.

Pribram, Karl H., ed., On the Biology of Learning
N.Y., Harcourt Brace & World, 1969, 225p., ref.

The physiology of learning and memory is presented, but without any reference to hemispheric differentiation.

Quarton, G.C., Melnechuck, T., and Schmitt, F.O., eds.,
The Neurosciences,
N.Y., Rockefeller U., 1967, 962p., ref., ind.

This contains "Split-brain Approach to Learning Problems." by R.W. Sperry, pp.723-33.

Rose, Steven P.R., The Conscious Brain
N.Y., Knopf, 1973, 343p., illus., bib., ref.

Various aspects of the conscious brain are explored, but not hemispheric differentiation.

Samples, Robert E., The Metaphoric Mind
Reading, MA, Addison Wesley, 1976

Samples advocates teaching the metaphoric and intuitive capacity of the human mind, and gives instructional experiments for the achievement of greater excitement, involvement, and transfer to other contexts. He believes that this stimulation is particularly critical in the eight to ten year range, just prior to the onset of hemispheric differentiation in normal cerebral development.

_____, Charles, C., and Barnhart, D.; eds,
The Wholeschool Book
Reading, MA, Addison Wesley, 1977

In which some of the above instructional experiments are expanded.

Schmidt, F.O., and Worden, F.G., eds.,
The Neurosciences: Third Study Program
Cambridge, MA, MIT, 1974

Contains "Why Two Brains?" by perception psychologist H.L. Teuber, p.71-4.

Shouksmith, George, Intelligence, Creativity, and Cognitive Style,
N.Y., Wiley-Interscience, 1970, 240p., bib., ind.

This New Zealand psychologist spells out the difference between convergent thinking and divergent thinking, and the interrelationship of these two modes of thought in problem solving and creativity. He does not tie these modes in with hemispheric differentiation, for at the time of his writing, he seems unaware of those neurological developments.

Tart, Charles T., States of Consciousness
N.Y., E.P. Dutton, 1975, 305p., illus., bib., ind.

This is concerned with altered states of consciousness and their induction.

Thompson, R.A., and Green, J.R., eds.,
New Perspectives in Cerebral Localization
N.Y., Raven, 1982, 254p. ind., ref.

A symposium of this title was held in Phoenix, Arizona by experts in the field of neurology and related sciences. The papers are highly technical. "Visual Cortex and Spatial Pattern Recognition," by D.A. Pollen, and S.F. Ronner (pp.35-46) focuses on spatial, non-linear neuro-function, and moves research one step closer to understanding how visual perception works.

Watzlawick, P., The Language of Change
N.Y., Basic Books, 1978, 172p., illus., bib., ind.

This psychiatrist outlines methods of communicating with the right hemisphere in order to effect change in psychiatric patients.

White, J., ed., The Highest State of Consciousness
N.Y., Doubleday, 1972

From subjective reports of feeling "high," theories are proposed.

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Lausanne, Societas Bibliographica, 1971

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